FIG. **4** is a schematic view schematically showing a hinge apparatus according to another exemplary embodiment of the present invention; and

FIGS. **5**A, **5**B and **5**C illustrate various usage states of an electronic device comprising the hinge apparatus according to an embodiment of the present invention.

FIG. **6**A shows the electronic device of the present invention in a closed state.

FIG. **6**B shows the electronic device of the present invention where the first body and the second body are rotated 360 degrees with respect to each other.

DETAILED DESCRIPTION

Exemplary embodiment of the present invention will now be described with reference to the drawings, in which examples of exemplary embodiments are shown. However, the present invention can be embodied in many different forms and should not be construed to be limited to the embodiments illustrated herein. Instead, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the present invention to those skilled in the art. In the drawings, for clarity, the sizes and relative sizes of the elements can be exaggerated, and the drawings are not necessarily drawn to scale.

FIG. **1** shows a hinge apparatus **100** according to an exemplary embodiment of the present invention; FIG. **2** is an enlarged view showing the mutual connection among the shafts of the hinge apparatus **100**.

As shown in FIG. **1**, the hinge apparatus **100** can comprise multiple shafts **10**. The multiple shafts **10** are arranged side by side in parallel with each other, and each two adjacent shafts **10** are connected to each other through a connecting element **12**, so that the multiple shafts **10** form a shaft chain altogether. As an example, FIG. **1** shows six shafts **10**. However, those skilled in the art can understand that the number of the shafts **10** is not limited thereto. A shaft chain can comprise more shafts **10**, for example, 10, 12, or more, and it can also comprise fewer shafts **10**, for example, three, four or five. However, in order to form the shaft chain so as to achieve the effect of a flexible shaft, the number of shafts **10** is more than three. Preferably, the number of shafts **10** included in a shaft chain is six or more to achieve a good flexible shaft effect.

Referring to FIG. **2**, each connecting element **12** connects two adjacent shafts **10** to each other. The connecting element **12** can have two shaft holes, and adjacent two shafts **10** are nested into the two shaft holes of the connecting element **12** respectively. A certain friction can be provided between the connecting element **12** and shafts **10**, thereby providing the torque required by the hinge.

FIG. **2** shows an example wherein two adjacent shafts **10** are connected to each other through only one connecting element **12**. In other embodiments, the two adjacent shafts **10** can also be connected to each other through two or more connecting elements **12**.

Referring back to FIG. **1**, a fixed connecting element **14** can be provided for each of the two outermost shafts **10** respectively, to connect the two portions (for example, the display portion and the keyboard portion of an electronic device, such as a notebook computer and a mobile phone) to be connected by the hinge chain.

If used in a narrower device, the hinge apparatus **100** can include only one shaft chain; if used in a wide device, the hinge apparatus **100** can include two or more shaft chains. FIG. **1** shows a hinge apparatus **100** comprising two side-by-side arranged shaft chains. Preferably, the numbers of shafts **10** included in the two shaft chains are equal to each other. Two or more shaft chains help to improve the stability of the connection.

When the hinge apparatus **100** comprises two or more shaft chains, a synchronization bridge chain can also be provided between the shafts optionally, so that rotations of the shaft chains can be synchronized. As shown in FIG. **1**, three synchronization bridges **16** can be provided between adjacent shaft chains, connecting the corresponding shafts of the adjacent shaft chains. Thus, the rotations of the corresponding shafts of the adjacent shaft chains can be synchronized with each other. FIG. **1** shows three synchronization bridges **16**, but it can be understood that a synchronization bridge can be set to connect each shaft in the shaft chain at most.

Alternatively, the hinge apparatus **100** can also comprise a covering element **18**. The covering element **18** can be made of flexible materials, such as rubber, leather and so on. The covering element **18** can cover the shaft chain formed by the shafts **10**, the synchronization bridge **16** connecting the shaft chains and a flexible printed circuit ("FPC") for transmitting data or providing electricity between the two portions connected by the hinge apparatus **100**. The edge of the covering element **18** can be hermetically connected to the portions connected by the hinge apparatus **100**, thereby achieving seamless connections between the portions, thereby being able to be waterproof and dustproof.

The hinge apparatus according to another embodiment of the present invention will be described below. The hinge apparatus can be substantially the same with the embodiment shown in FIG. **1** except the connection between the same shafts in the shaft chain. Therefore, the following description will focus on the difference and the repeated description of the same parts will be omitted. It should be understood that except the difference described below, the description of the embodiment of FIG. **1** can also be applied to the hinge apparatus according to the present embodiment. FIG. **3** is an enlarged view showing the connection between the shaft **20** and the connecting element **22** in the hinge apparatus according to the present embodiment.

As shown in FIG. **3**, the connecting element **22** provides a baffler **23** around the shaft holes, and shaft **20** can also provide a projection **21** on its outer circumferential surface. The baffler **23** can block the rotation of the projection **21**, thereby limiting the rotation angle of the shaft **20** with respect to the connecting element **22**. It can be understood that by limiting the rotation angle of each shaft **20** with respect to the connecting element **22**, the case where the rotation angle of some shafts is too large whereas the other shafts almost do not rotate can be prevented, so as to achieve the even rotation of each shaft, so that the shaft chain can bends smoothly. In order to make the hinge achieve a 360-degree rotation, the average rotation angle of each shaft with respect to the connecting element **22** is not less than 180/(n−1) degrees; if a 180 degree rotation is to be achieved, the average rotation angle of each shaft **20** with respect to the connecting element **22** is not less than 90/(n−1), wherein, n is the number of shafts **20** included in the shaft chain and n is more than or equal to three. Of course, the rotation angle of each shaft **20** with respect to the connecting element **22** can be set different so as to achieve the desired bending state of the shaft chain. For example, from both sides of the shaft chain towards the middle of the shaft chain, the rotation angle of the shaft **20** with respect to the connecting element **22** is set to be gradually increased.

The projection **21** and the baffler **23** can not only limit the degree of the rotation angle between the shaft **20** and the connecting element **22**, it can also limit the relative positions of the two in the rotation direction, so as to define the shape